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Matthew Schehl | September 28, 2018

A team of NPS researchers prepares to launch an unmanned aerial vehicle during an experiment in swarming unmanned systems at the latest Joint Interagency Field Experimentation program.

CAMP ROBERTS, Calif.-From the blistering tarmac at McMillan Airfield, a lightweight unmanned aerial vehicle (UAV) catapults off and directs itself into a forming swarm of fellow UAVs. A few hundred meters away, with its mission completed, a ScanEagle UAV

autonomously swoops in to hook onto a dangling line for retrieval.

Twelve kilometers beyond the airfield, a pocket-sized UAV teaches itself to navigate a dense urban environment to recognize and follow a moving vehicle, while another UAV locates the survivors of a downed helicopter to airdrop relief supplies.

These are a just a few of the many experiments carried out at the latest Naval Postgraduate School (NPS) Joint Interagency Field Experimentation (**JIFX**), held Aug. 6-10 at the California National Guard's Camp Roberts.

Coordinated by NPS' Consortium for Robotics and Unmanned Systems Education and Research (**CRUSER**), the quarterly JIFX event brings together leading minds from academia, industry and the military to sandbox emerging technologies in austere field conditions in central California.

"It really is a collaborative learning environment with minimal rules," said Dr. Ray Buettner, JIFX director and NPS associate professor of Information Sciences. "People come out, interact and share information, and it's done with only enough structure to be safe, secure and legal."

Over the five-day event, NPS students and faculty, representatives from various U.S. military commands, and specialists from cutting-edge tech firms endured the sweltering heat to put a range of new systems to the test.

Next-generation unmanned autonomous systems (UAS); drone swarms (and techniques to counter them); UAS specific to humanitarian assistance and disaster relief missions; long-range communications; and, cyber resiliency experiments were all conducted over the course of the week, often with surprising results.

"It's OK to come out and laugh about the fact that an experiment didn't work. This is what we did [wrong], and we're trying this tomorrow'," Buettner said. "Then other people will say 'Have you checked this? Have you thought about that?'"

"That community vibe is really what it's all about," he stressed.

This thriving esprit de corps is driven by the underlying fact that JIFX has little to do with the acquisition of product, and everything to do with finding solutions ... finding what works, and what doesn't work, in meeting the needs of the Department of Defense.

The venue offers participants the rare opportunity to test out new systems in an operational setting. JIFX provides a deconflicted federal airspace across a wide range of terrain, including urban buildings and tunnels, forests and open plains – all with direct input from potential end-users and academia.

"People at JIFX are participants, not vendors," Buettner said. "Vendors try to sell you something; participants are part of this exploration, this learning process."

In an era in which the U.S. military is attempting to adjust course to meet the challenges presented by the emergence of peer competitors, finding creative and innovative ways to connect military and industry has become increasingly critical.

While transparency and impartiality in acquisition remain important, a wall between industry and military exists analogous to the pre-9/11 barrier between intelligence and law enforcement, according to Buettner.

"At JIFX, we create an environment that tries to poke holes in that wall so that industry is aware of the government challenges and the people on the government side who make requirements are aware of industry's capabilities," Buettner explained. "We have to find a way to get through that wall to stay more agile and connected to industry."

Since 2002, JIFX and its predecessor programs have excelled at doing precisely that, and continue to find new ways to do so.

This summer's iteration saw the first formal inclusion of NPS students not directly participating in any of the experiments.

Several dozen students from two different programs within the NPS Department of Information Sciences, headed out to Camp Roberts to observe the myriad experiments being conducted, providing them first-hand interaction with the emerging technologies which will become the bread and butter of their careers.

"JIFX is one way to educate our students who will be the future government representatives making the big decisions about how to stay connected to industry," Buettner explained. "JIFX is not about acquisition – no one's buying anything – but it's the kind of environment where people build relationships talking about technical challenges and issues. That can be really valuable going forward when trust is an important part of most contractual arrangements."

For U.S. Marine Corps Capt. Christine Dullnig, pursuing dual masters at NPS in Information Warfare and Space Systems Operations, observing the experiments at JIFX provided an invaluable experience that could not be gained from a textbook.

"We were able to look at different innovations and see how far along their readiness levels are, and how well their systems are integrated with different software and functional areas," she noted. "This will allow us to stay abreast of the technology that we're going to see in the Fleet."

The industry representatives at JIFX also gained from interacting with NPS students, who bring a wealth of experience to the table. The experimentation in autonomous curiosity conducted by Carnegie Mellon University (CMU) is a prime example of the interactions JIFX makes possible.

Machine learning and object recognition have become the technological cause du jour, but CMU is taking this to the next level by having a UAS swiftly teach itself to navigate and search for a target through dynamic and complex environments.

Real-time autonomous curiosity allows a system to learn to adapt to its surroundings in the same way as a four-year-old at a zoo knows to look around an obstacle in response to 'that's a lion over there!', explained Dr. Bob Iannucci, CMU distinguished service professor in electrical and computer engineering.

"Imagine a warfighter in an emergency rescue situation. You don't know specifically what you're looking for until you get there: someone who is trapped, someone in the woods or in a particular car that you need to follow," he said. "We're trying to train a drone to have that same sort of intuitive sense of how to recognize a visual target."

Five hundred meters away from Iannucci's improvised command post in Camp Robert's Combined Arms Collective Training Facility, the tail of a notionally-downed helicopter juts out a massive pile of rubble.

With just one click, his team's UAS speeds off through the sprawling urban training complex to seek out and recognize the target.

"The drone, when it takes off, understands colors, shapes, textures and the basic stuff that makes up computer vision, but it doesn't know that particular helicopter," Iannucci said. "So what the drone will do is try to keep that image in view, and as it moves, it's able to keep tracking the parts of the image that we said were interesting and get a better sense of this three-dimensional object as being distinct from the background."

The JIFX environment affords Iannucci and his team the freedom to pursue this in a way that is not possible at the CMU campus, both in terms of airspace and radio frequencies availability. Moreover, their experimentation transcends what is possible in a purely academic environment or computer simulation, he said.

"NPS has done an absolutely fantastic job in setting up and running these events," Iannucci said. "We've been to 12 now, and we keep coming back because it's so beneficial; we can't get this kind of value any other way.

"Selfishly, I like it for that reason," he continued. "But more than that, it's the community that NPS has created among experimenters that include government, academia and companies all coming together in a way that is not about commercializing products, but about the bounds and limits of technology."

With its summer iteration concluded, CRUSER is already gearing up for its next JIFX event, **19-1**, slated for October 29-November 2.